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ABSTRACT

This research project was designed to evaluate the synergistic effects of linking workshops for science teachers with electronic conferencing. The rationale for this study was that these two methods of professional development and communication would have an impact beyond that which either would have alone. Included are the abstract, a description of the workshops and computer conferencing, evaluation, a discussion of the relationship between workshops and computer conferencing as professional development tools for teachers of science, the conclusion, recommendations, and a description of project products. (KR)

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Examination of a Strategy for Maximizing Teacher Implementation of Workshop Learning Experiences Through the Use of Electronic Conferencing

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Examination of a Strategy for Maximizing Teacher Implementation of Workshop Learning Experiences Through the Use of Electronic Conferencing

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TABLE OF CONTENTS

		Page
I.	Abstract	1
II.	Project Activities	2
	A. Workshops	2
	B. Computer Conferencing	4
	C. Evaluation	6
	D. Study of Relationship Between Workshops and Commputer Conferencing as Professional Development Tools for Teachers of Science	6
III.	Conclusions	15
IV.	Recommendations	16
V.	Project Products	17

MVSTSN STRATEGY FOR COMPUTER CONFERENCING/WORKSHOP LINK

Abstract

This research grant project was designed to evaluate the synergistic effects of linking workshops for science teachers with electronic conferencing, during the period of September, 1987 through February, 1989. The rationale for this study was that these two methods of professional development and communication (workshops and telecommunications) would have an impact beyond that which either would have by itself. We have found that:

- Science teachers, K-12 and college, public and private schools, need and want professional development opportunities and collaboration and therefore will become committed to an ongoing group and each other for purposes of learning, sharing resources and support.

- There is no relationship between how often a teacher applies workshop learning in the classroom and the teacher's on-line communication with workshop co-participants.

- For two-thirds of the teachers studied a very strong commitment to the group was not enough to overcome other barriers to computer conferencing in a computer conferencing system designed for general, ongoing use by science teachers.

- Success in on-line conferencing is related primarily to a teacher's learning and communication styles, secondarily to hardware and software issues, and not related to the teacher's motivation to learn, affiliation with the group or the amount of support the teacher received from his/her school system.

This study is distinguished from others by:

- the makeup of the teacher collaborative (K-12 and college teachers from diverse school settings as peers);

- the study's examination of the use of telecommunications by a group of teachers who were not compensated for participating in the workshops, computer conferencing or this study.

We saw the latter characteristic as essential to the study, in order to provide subjects who would make natural choices representative of a teacher who might choose workshops and/or telecommunications as a means of furthering his/her professional development. The study builds on its predecessors, such as the outstanding work done at New Jersey Institute of Technology by Drs. Howard Kimmel, Elaine Kerr and Mark Shea.

MVSTSN/STARS (the Merrimack Valley Science Teachers' Support Network, now known as Science Teachers' Area Resources Swap) was and is a group of teachers of science, which includes both public and private school teachers from all levels, K-12 and college, as peers and colleagues. All the members of MVSTSN/STARS are members by choice, who have responded on their own initiative to invitations to attend workshops and become part of the collaborative. Those thirty teachers who comprised the subjects for this study were selected from the MVSTSN/STARS membership.

Project Activities

Workshops

During the course of this study of the interactive professional development effects of workshops and computer conferencing, MVSTSN/STARS provided four workshop days per school year and an afternoon planning session in May in which teachers planned their professional development activities for the following academic year. The topics, meeting locations and dates for each workshop day were selected by the teachers, who participated in annual planning meetings, held at Tewksbury Memorial High School, in mid-May of 1987 for 1987-88 and in mid-May of 1988 for 1988-89. Those who could not attend the planning meetings were invited to send in their suggestions for topics, meeting dates and locations, to give maximum control to the teachers in planning their own professional development.

All workshops were a full day. Workshop funds were used to provide coffee at registration and the morning break, lunches, and workshop materials for the teachers to take home and use in their teaching, as well as to provide stipends for the workshop presenters. Once each academic year, the workshop day was devoted to 'Member Generated Workshops' in which MVSTSN/STARS teachers who had attended summer institutes or worked on other curriculum projects provided the workshop presentations.

To reach as many teachers as possible for this project, two mailing lists were prepared, one (updated after each workshop) of teachers who had attended MVSTSN/STARS workshops and the second (annually updated) containing science teachers from as many schools as possible in northeastern Massachusetts. The first list included about 100 teachers at the start of the grant project and has

grown to now include 250 teachers, including several from New Hampshire and Maine. This list was used for mailings for every workshop. The second list contained about 450 teachers at the start of the project and now is estimated to include about 1500 teachers, including several from western and southern Massachusetts, as well as Maine, New Hampshire and Rhode Island. The longer list was used to send a bulk mailing once each year, with the workshop schedule for the year. Efforts are being made to steadily increase the number of elementary and middle school teachers on both lists.

The workshops which teachers attended over the life of this grant were:

WORKSHOP	DESCRIPTION	HANDOUTS AND NUMBER ATTENDING
9/26/87	Lowell High School - Dr. Robert Swartz of U Mass/Boston INCORPORATING THE DEVELOPMENT OF CRITICAL AND CREATIVE THINKING SKILLS INTO THE SCIENCE CURRICULUM	NEA's THINKING SKILLS INSTRUCTION & Freeman's TEACHING THINKING SKILLS 20 members attended.
11/17/87	Medford High School - Dreyfus/Woodrow Wilson Teachers Mark Ryan of Medford HS and Kathleen Skelly of Dana Hall with colleague Hazel Schroder of Shrewsbury HS and Conant and Timm Awardee Dr. Ronald Pike of Merrimack College MICROSCALE CHEMISTRY EXPERIMENTS AND DEMONSTRATIONS	Kits of the basic microscale equipment, e.g. pipets, storage boxes, batteries, syringes and information on where and how to obtain more 45 members attended..
1/30/88	University of Lowell - MEMBER GENERATED WORKSHOPS Philip Lamprey of U Lowell & Dave Adams of Bradford College - Keynote: SHOULD WE TEACH ETHICS AND VALUES IN OUR SCIENCE COURSES? Dorothy Bagley of Shrewsbury HS - WOMEN IN SCIENCE: ENCOURAGING YOUNG WOMEN TO PURSUE CAREERS IN SCIENCE/MATHEMATICS/TECHNOLOGY Judy Donovan & Ruthann Budrevicz of Reading Memorial HS - WRITING ACROSS THE CURRICULUM Stephen Gerome of Tewksbury Memorial HS - APPLEWORKS SPREADSHEETS FOR THE LABORATORY: STUDENT DATA RETRIEVAL, LABORATORY DATA INPUT AND RETRIEVAL Phyllis Sonnenschein of Burlington HS - VISUAL AIDS FOR TEACHING BIOLOGY Don Hilton of U Lowell - STUDENT MADE X-Y-Z MODELS OF PHYSICO-CHEMICAL SYSTEMS Bette Bridges of King Phillip Reg HS - HOUSEHOLD CHEMISTRY: HOUSEHOLD PRODUCTS IN EXPERIMENTS AND DEMONSTRATIONS. Keith Seitter & Frank Colby of U Lowell - USING REAL-TIME WEATHER DATA IN THE CLASSROOM: TIPS ON ACCESSING U LOWELL'S WEATHER SATELLITE DATA SYSTEM. General Demonstration and Laboratory Experiment Swap	Each teacher was able to attend the Keynote Address, two workshops and the afternoon session on demonstrations. All of the workshop presentors provided written, how-to materials. In addition, Dr. Hilton provided computer disks and materials for the models. Ms Bridges provided samples of cobalt chloride for humidity detectors. 60 members attended.
3/24/88	Shrewsbury High School - Applications of Optical Technology in Education Stephen Gerome of Tewksbury Mem HS - INTRODUCTION TO VIDEODISC TECHNOLOGY Tom Platt of Shrewsbury HS - INTERACTIVE VIDEODISCS AND HYPERCARD Barbara Streuli - CD-ROM APPLICATIONS	Presentors provided handouts on the types of technology and how to obtain them. 23 members attended.

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9/24/88	Bradford College - The Chemistry Curriculum: What It Is & What It Could/Should Be William Chase of Winchester HS - CHEM-COM WORKING GROUPS ON - THE CHEMISTRY SYLLABUS; THE CHEMISTRY LABORATORY (A paper for publication is expected to come from the work the teachers did at this workshop.)	Each teacher supplied a syllabus and a favorite experiment. These were duplicated for all workshop participants. 35 members attended.
11/16/88	Natick High School Clayton French of University of Lowell - RADIATION AND LIFE Kenneth Kustin of Brandeis Univ - OSCILLATING REACTIONS & DISCOVERIES IN SCIENCE Edward Jameson of Natick HS - STARS,STAMPS AND SHAKESPEARE	Edison's LASER HOLOGRAPHY: EXPERIMENTS YOU CAN DO and articles "Radon - Home Evaluation" and "Briggs - Rauscher Reaction" were sent to participants along with a summary of the findings and the minutes of the meeting. 23 members attended.
1/28/89	Phillips Exeter Academy - MEMBER GENERATED WORKSHOPS Jerry Bell of Simmons College - Keynote: HOW WE KNOW WHAT WE KNOW Jennifer Hickman of Phillips Academy and Paul Hickman of Belmont HS - OPERATION PHYSICS Mark Ryan of Medford HS - C4ET - CHEMISTRY FOR ELEMENTARY TEACHERS Nancy DeLuca of U Lowell - SCIENCE FOR THE PHYSICALLY DISABLED STUDENT James Eckstrom of Phillips Exeter - VIDEODISC TECHNOLOGY FOR BIOLOGY CLASS AND LAB Phyllis Sonnenchein of Burlington HS - WHY HUMAN GENETICS IN THE BIOLOGY CURRICULUM Don Hilton of U Lowell - TEACHING CHEMISTRY THROUGH POSTAGE STAMPS General Demonstration Swap.	Presentors supplied handouts. As was the custom at all workshops, door prizes of useful books and items such as the RSC Time-Life Periodic Table were provided. 29 members attended.

Computer Conferencing

For this study, the University of Lowell purchased a license and annual maintenance contracts for CoSy, the conferencing system developed by the Univerity of Guelph, Guelph, Ontario. This software was deemed the most user friendly of those developed to operate in the VAX/VMS environment made available to us on the Univerity's Academic Computer Center computer. Grant funding was used to train the moderators (those who would keep on-line conversations going in a number of science areas), and to pay them a modest stipend of $100/month to be on-line daily, if possible.

After familiarizing ourselves with the conferencing software, the first step in ensuring the success of the computer conferencing part of our study involved bringing Dr. Howard Kimmel, from New Jersey Institute of Technology, to the University of Lowell, November 7, 1987, to train several potential moderators for the on-line conferences. The goal of the training was to be sure that the moderators understood the time commitment needed from them and the factors which are most apt to encourage, rather than discourage, computer conferencing participation on the part of users. At the end of this training session we had firm commitment from four teachers, willing to fulfill this important role for the

study. Several CoSy users have commented on the collegial and welcoming atmosphere on CoSy, a tribute to the moderators and their training.

By the end of December 1987, thirty teachers from among the MVSTSN/STARS teachers were selected for our study. Each received a letter confirming their commitment to the study. All thirty teachers agreed to attend at least two workshop days over the course of the study and to providing such data as we would ask them for at the end of the study. The fifteen who were to be on-line on CoSy also agreed to try to be on-line at least two days per week.

On January 30, 1988, the day of the Member Generated Workshops at the University of Lowell, the fifteen teachers who were to be on-line for the study, plus about another twenty teachers who were interested, attended an afternoon training session on using the conferencing system. Our goal was to have each teacher become comfortable with sending mail and with leaving at least one message in an open conference. At this point teachers were very concerned about leaving public messages which might have typographical errors in them (something most conferencing enthusiasts take for granted and do not worry about). Online editing is often difficult. This hurdle of teachers' concerns about their appearance 'in public' is one we believe was never satisfactorily overcome.

At the time of the January 30 training session, several teachers were supplied with Apple compatible modems, through a State grant administered by the Center for Field Services at the University of Lowell. Within the following month, three additional teachers were supplied with Commodore compatible modems through overhead funds assigned to the discretion of the Principle Investigator by the University of Lowell Research Foundation.

At the start of the second academic year of this project, on September 17, 1988, a second half-day training session on using CoSy was held for the teachers. (We have found, as has Dr. Kimmel and his colleagues at EIES, that September and January, traditional starting times for teachers, are normally the best times for introducing teachers to conferencing technology.) During this training session, teachers were paired with each other in hopes that they would consider their buddy an ongoing source of support after the session. At the conclusion of the session, teachers were also connected with a member of the team (a moderator or a grant team member) who used the same type of personal computer as they did, so they would have a resource person to consult with if/when they ran into difficulty trying to connect with CoSy over telephone lines from their homes or schools.

Direct training was provided to four teachers by two grant team members and a moderator. In addition, telephone consultations were provided to those who sought them.

Evaluation

Much of the data collection for the project was carried out by the grant team, itself, in accord with the study design planned for the proposal with Dr. George Hein of the Program Evaluation and Research Group of Lesley College. In the interest of being able to obtain data to open-ended questions from in-depth interviews, we opted for a qualitative research design. In addition to objective data (meetings attended, type of on-line messages sent), we have been able to analyze interview data and code it for emerging, often unexpected themes (such as primary motivators for a teacher's workshop and on-line participation).

Since the length of time for the grant and its funding was reduced from that of the proposal, the evaluation plan was modified to eliminate school visits. In addition, the necessary software development to allow statistical studies of on-line participation patterns of the study subjects was not completed until spring 1989, so logs of on-line participation of study subjects do not exist. Neither of these changes has impaired the assessment of the original study hypotheses.

In the spring of 1988, one of Dr. Hein's research assistants, Susan Cohen, on the basis of interviews with the project staff, provided the staff with formative evaluation regarding ways to more efficiently achieve our tasks.

Project records show who attended each workshop and contain copies of all handouts provided at the various workshops. Written feedback was obtained from half the subjects in June 1988 and from all but two of the subjects in the spring of 1989. In March and April of 1989, another of Dr. Hein's research assistants, Candace Lee Heald, interviewed all but two of the study participants by telephone to obtain anonymous feedback regarding the teachers' use of workshop information and their participation or lack of participation on CoSy. It should be noted that the two teachers who did not provide written feedback did provide telephone interviews, and the two teachers who were not available for telephone interviews did provide written feedback, so we obtained data from all thirty study participants.

Study of Relationship between Workshops and Computer Conferencing as Professional Development Tools for Teachers of Science

1. *Original Hypotheses*

Over a two year period, teachers who participate in workshops together and regularly communicate with each other via computer conferencing will

exhibit certain characteristics not demonstrated by teachers who participate in the workshops but not the computer conferencing. These characteristics are:

- implement what they have learned in the workshops;
- modify what they have learned in workshops to meet their own needs;
- create and share new ideas with their peers;
- be committed to and actively involved in the decision making and planning activities of their support network.

2. *Additional Hypothesis* - from unexpected findings

There are personal attributes in addition to or beyond motivation and hardware/software problems which determine whether or not a teacher is successful at using telecommunications on a regular, ongoing basis.

3. *Subjects*

For the purposes of this study, thirty teachers were selected as project subjects. All 30 committed themselves to attend at least two of the MVSTSN/STARS workshops. Fifteen of the 30 were selected to be on-line. These 15 agreed to commit themselves to being on-line at least twice a week.

It is important to note, again, that the teachers were not compensated for attending workshops or spending time on-line. It was essential that they choose to donate their time, so that the study conditions would most closely approximate the real conditions under which teachers attend workshops and use computer networks.

The on-line and off-line subjects were matched in several ways:

	On-line	Off-line
Male/Female	7/8	8/7
Public/Private School	11/4	11/4
K-12/College	12/3	14/1
Computer Literate*	14	12
Experienced with Modem/Telecommunications**	2	0

* At start of project used a computer regularly, e.g. for wordprocessing, database management, data collection in the laboratory.

** At start of project had been using other telecommunications networks

4. *Sources of Data*

The most useful sources of data for the qualitative assessment of this project, for the purposes of comparing on-line participants with off-line participants and for comparing successful on-line participants with unsuccessful on-line participants were:

- project records and interviews with project staff;
- mid-project and end-of-project questionnaires completed by the 30 participants;
- end-of-project anonymous interviews of the participants by the outside evaluators;
- on-line contributions.

5. *Findings*

Of the thirty teachers who committed themselves to attending at least two workshops during the course of the study, one did not attend any, five attended only one, five attended two, and nineteen attended more than two (ar 80% success rate).

Of the fifteen teachers who committed themselves, also, to being regular CoSy users, only five succeeded (a 33% success rate). Evaluation of the data has helped us identify a number of factors influencing the ability of participants in a wide-area telecommunications network to get on-line. These fall into two broad categories:

- personal attributes, such as one's learning style, expectations and priorities;
- external factors, such as hardware/software issues and support from one's school system.

The former, personal attributes, appear to have greater bearing on a teacher's success with telecommunications than the latter, though both are important.

Regarding the successful use of telecommunications by the 15 on-line study subjects:

- Five subjects were considered successful on-line participants as they were on-line on a regular basis throughout the study. (None of the subjects achieved the twice weekly on-line participation envisioned at the start of the project, though three became quite active, eventually moderating conferences. A number of other teachers, not part of the study, became successful CoSy participants.)

- Three subjects were considered somewhat successful in that they were on-line for a short period of time at some point during the study. (A number of other teachers, not part of the study, became somewhat successful CoSy participants.)

- Seven were considered unsuccessful, in that, except for the training sessions, they were not on-line at all.

Data on personal attributes related to success with telecommunications:

1. *Motivation/Commitment to the project and group are not factors in determining one's success with telecommunications, as the following data attests:*

   - All but two of the 15 on-line subjects met their commitment to attend two workshops. Most attended more than the two they had committed themselves to attending at the start of this study. The two who did not attend two workshops were not successful on-line, but one of these two who attended one workshop falls into the next category - demonstrated commitment to the group.

   - Willingness to spend time serving the group was not a predictor of success on-line. Five on-line subjects hosted workshop days: 3 unsuccessful at telecommunications, 1 somewhat successful and 1 successful. Also, seven on-line subjects have volunteered to serve on the Board of STARS: 4 unsuccessful at telecommunications, 2 somewhat successful and one successful. (One of the two subjects who chose to attend one workshop, rather than two, and who was successful on-line, was both a workshop host and a Board member.)

2 *Comfort level with computers, as an attribute, was not a significant predictor of success.*

e.g. Three unsuccessful subjects:
- "I needed someone over my shoulder. I haven't had the time to figure it out. But I am comfortable with the computer. I know word processing, spread sheets and data bases."
- "I'm not computer literate. It looked good, but never had the time and I'm not the type to initiate it."
- "I teach physics and labs and am in charge of microcomputers. CoSy is not part of my priorities."

vs Two successful subjects:
- "Excited to get in on the ground level. Learning through the process. Since have become part of many systems."
- "Difficult to log on the first time, even for the computer literate. I was a hacker and it's very different using the computer and the modem program."

3. *Many attributes, though not specific predictors of success are strongly related to success:*

ATTRIBUTE	SUBJECTS Unsuccessful	Somewhat Successful	Successful
Attributed difficulties encountered to: self(ME) vs system(SYS)	5 ME/2 SYS ME <---------- e.g. "It wasn't that I wasn't persistent. I couldn't get hooked up, get in. It got taught at U Lowell and I couldn't make it work at home."	1 ME/2 SYS ----------	0 ME/5 SYS ----------> SYS e.g. "Problems were technical.. but it doesn't discourage me. Thrill, this is my first experience."
Needed 1:1 assistance with remote access: needed but didn't ask(N) asked(A), didn't need(D)	5 N/1 A/1 D N <---------- e.g. "Trouble with modem. No time to call."	0 N/2 A/1 D ---------- e.g. "Major problems trying to get access. Contact person at U Lowell. I needed some-one to sit beside me."	0 N/3 A/2 D ----------> A/D e.g. "Went to 2 or 3 workshops to be adept."
Gender: female(F) vs male(M)	6 F/1 M F <----------	2 F/1 M ----------	0 F/5 M ----------> M
Expected telecommunications to provide: ideas(I) or human interaction(HI)or both(B)	5 I/1 HI/1 no data I <---------- e.g. "Be able to take care of problems immediately. Get answers faster than by phone."	1 I/2 B ----------	1 HI/4 B ----------> B e.g. "Hoping to get support from science teachers like me & ideas"
Names as major barrier to on-line participation: priorities/time (P) or access problems(A) or both(B) or neither(N). Access problems were mentioned by 11 of the 15 subjects.	4 B/3 P P <---------- e.g. "Personal issues.I'm low on the seniority list and I might be losing my job. My energy is other places."	2 B/1 A ----------	1 B/3 A/1 N ----------> A e.g. "Time. Initially the most difficult thing is getting on-line."

Success at telecommunications, though not gender-specific, appears to be gender-related. In addition, those who see the problems as attributable to vagaries in the system, rather than themselves, who are willing to ask for help,

who see teleconferencing as a source of support as well as ideas, and who are persistent can and do succeed at computer conferencing.

4. *Participants were more persistent in their attempts to participate if they perceived beneficial outcomes from what they were doing.*

On-line projects are more successful when they are short term and have tangible, measurable indications of accomplishment. If possible, one or more outcomes should be of direct benefit to the students of the participants.

The conferencing system needs to provide teachers with both useful information and support. E.g. Samples of what the participants found useful:

- "Lots of (chemical) storage and safety issues. Need continual support. There are lots of questions to ask and many variables. Disposal and right to know issues. Need support I'm not getting at school. I could find the answers by using CoSy."
- "Some collegial interchange, at least. The expectation was met three times over."
- "Generating dialogue ... elements of (one's) discipline, the way things work, responses to demonstrations, kits for loan, where they are offered, and announcements."
- "People contact, sharing information, like women in science stuff, updating (myself), problems with lab, use ideas from others."

In addition, some of the data for this finding come from comparing our 15 on-line subjects with the teachers in another on-line project on CoSy called KITES. In the KITES project there was 100% participation by the teachers, though at the beginning of their being on-line their comments indicated they were experiencing all the difficulties and resistance exhibited by our subjects. KITES involved on-line planning by middle school teachers from three neighboring school systems for biweekly, live, joint televised classes. As the teachers could not come up with a common time for face-to-face meetings, the only way they could be ready for the televised classes was to 'meet' on-line. The ultimate goal of the KITES project was for the local classes of children to participate in a live, joint televised class with children in Germany, which occurred in June, 1989. (Information on this project may be obtained from Dr. John LeBaron, College of Education, West Campus, University of Lowell, Lowell, MA 01854.)

External factors which contributed significantly to one's on-line success.

1. Hardware software issues

As noted in other studies, subjects faced problems with both the software and hardware they used. Giving assistance was often difficult because many types of hardware and software were in use. One set of modems and software arrived with particularly poor documentation, which added to the difficulties experienced by those new to telecommunications. The project team provided from among their members an Apple, an IBM and compatibles and a Commodore consultant, whom subjects were encouraged to call if they were experiencing any difficulty. As noted above, not everyone took advantage of these three consultants.

In addition, it was noted that some teachers shared among themselves communications software they thought especially good. Such shared software rarely is passed along with documentation. This meant that an inexperienced teacher using this software s/he "knew to be good" had difficulty followed by a sense of failure. The real problem was the teacher's not having documentation on hand to assist her or him.

Inherent with telecommunications are problems that arise through no fault of the participant. On the user's end, telephone lines, modems, and interface cards are components that computer users do not encounter often. For success, the communications package requires a more complete proficiency sooner than the typical word processor or spreadsheet program with which most teachers have had experience.

On the conferencing system end, there are access factors which range from the simple in a microsystem (not enough telephone lines or facility for simultaneous users) to the complex in a multiuser system such as the one at the University of Lowell, where the unforgiving broadband link between the telephone line and CoSy caused and causes a continual, frustrating set of access problems of a seemingly random nature, which are very discouraging to new users.

2. School-related issues

Given that STARS teachers were from diverse school systems and on their own initiative had sought out professional development opportunities, we encouraged the on-line subjects to participate on-line either from home or school, whichever was most convenient. Where necessary, we provided some teachers with modems, to ensure having a true cross section of the teachers among the on-line participants. Some had access to systems at school (S), some

at home (H) and some both (B). Those who were most successful were those adept at negotiating for what they needed at school, even in the face of considerable odds.

Unsuccessful	Somewhat Successful	Successful
3 H/2 S/2 B	2 H/1 B	1 S/4 B

e.g. Home user/unsuccessful user
- "Setup at home. Difficulty getting school to do it. No phone line (in her part of building). Too complicated."

School user/unsuccessful as CoSy user, though occasionally accessed Physics Forum at U Mass/Amherst
- "At high school good setup in one room. Use it during school hours and after school."

Both home and school users/successful
- "At school I have a computer with no phone line. I have to move the computer to the elevator and up to the second floor to the computer office. But they have a self-dialing line. Most often I prepare message off-line, convert it to ASCII, bring computer and modem home."
- "Two of them. Outside my office and in living room. Modem and phone line. Majority of my time at home ... My students also use it at school."

3. *Training issues*

A variety of factors, some addressed by the trainers others not evident to them at the time of training, influenced the outcomes of the study. Participant learning styles and needs were quite varied and not fully understood by the project staff. CoSy is a command driven conferencing system. It became apparent that some people preferred a command driven system, while others would have preferred a menu driven system.

The primary issue, however, was the perceived need, by most participants, for one-on-one assistance at **their** site, with initial access to the conferencing system.

e.g.

From one of our off-line subjects who wants to be on-line now that the project study is completed:
- "It's getting over the initial hurdle. I want to send things, but getting used to the software, I have ASCII Express, but no way! The information is worth the time, but do I have

the time? I am a visual learner. I want someone to come to my house and I do it. The CoSy stuff I understand. It's not CoSy. It's booting up the software and using the modem and delving into the unknown. I can't explain how to use a modem."

Conclusions

Based on the findings, the study team concludes that the STARS organization is a group of dedicated teachers who have responded to the need for K-12 and college science teaching collaboration. Because of this collaboration, science education in the Merrimack Valley area has been enhanced. Resources have been shared among the members of the group and between the collaborative members and colleagues at their schools who are not STARS members.

Despite the efforts of the teachers to create a supporting telecommunications network, personal and external factors have created major barriers for two-thirds of the on-line study subjects. The primary issue is one of personal priorities. The next most critical issue is that of helping participants overcome the hurdle of the learning curve in learning how to gain access to the system.

High success rates are obtained when teachers understand that telecommunications problems are solvable and attributable to system, not just themselves, that there is a social dimension to telecommunications, specific tasks to be accomplished, and ready access to useful information for themselves and their students.

Recommendations

Groups in which K-12 and college science teachers from diverse public and private schools function as colleagues meet real needs for all participants for learning, sharing resources and support. Growth of such groups should be encouraged.

With regard to supporting the growth of general purpose telecommunication systems for teachers, the following issues need careful consideration:

- In order to take into account the differing learning styles of teachers, priority needs to be given to providing participants with ready access to a person who can come and assist on site. A conference system with both command driven and menu driven options would be of further value in aiding teachers with different approaches to conceptualizing their task.

- The apparent relationship between on-line success and the personal factors of attribution of fault (to the system), gender (male) and a willingness to ask for help (when one's learning style benefits from 1:1 trouble shooting) suggest fertile ground for further research. For those wishing to develop telecommunications projects with a good cross section of teachers committed to professional development, these results strongly suggest the need to consider a diversity of learning styles when planning the type of training and support needed to help teachers become proficient in on-line conferencing.

- The initial access problems seem to be the greatest hurdle for teachers and yet their most desired solution, one-on-one assistance at their site places a major demand on project resources and personnel.

Recommendations from the teachers

The participants identified six competencies necessary to be successful in a telecommunications environment:

- knowledge of how to set up and use a microcomputer;
- ability to set up a modem;
- fluency in the use of the communications package being used;
- an understanding of how the telephone system works;
- a working knowledge of the mainframe or minicomputer environment on the other end of the phone line;
- proficiency in the use of the conferencing system being used on the host computer.

Teacher comments about other needs:

- "Needs motivation and time training and available help. Also, need personal persistence."
- "It is a stimulus-response training. Once it works, try it again. Close to that model. At some point everyone is busy and it is too hard. Everyone has a bunch of things. If you fail, that remains with you longer than the success. It will be a while before you try it again."

Project Products

Complete files of workshop materials will be shared on a continuing basis with MVSTSN/STARS teachers.

Many study participants have supplied information on how they have applied what they learned in the workshops. This will be shared in the MVSTSN/STARS newsletters which will begin publication during the 1989-90 academic year.

A report on the project results has already been presented at the Triangle Coalition/NSF supported NATIONAL ELECTRONIC NETWORKING IN K- 12 SCIENCE, MATHEMATICS, AND TECHNOLOGY EDUCATION CONFERENCE, July 26- 28, 1989, Wingspread Conference Center, Racine Wisconsin. It is expected that project data will be presented by the project team at additional conferences during the coming year.

A paper for publication of study results is in preparation. An additional paper on the teachers' views of the chemistry curriculum will be prepared for publication, as well.